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Comparison of the results of rearing the suckling piglets, receiving different iron preparations

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Abstract: *Comparison of the results of rearing the suckling piglets, receiving different iron preparations*. The aim of the studies was determine the results of rearing the piglets which received three different preparations of iron (Fe) by injection. The sows, the progeny of which was covered with the observations, were at random assigned before parturition, to one from three experimental groups – E1, E2 and E3 (five sows in each group). The rate of growth, feed utilization and health state of the piglets from birth until weaning (35th day of life) was controlled. The highest body weight of five-week old piglets was recorded in group E3; the difference in relation to body weight of the piglets from groups E1 and E2 was equal to 3.47 and 13.15%, respectively (P >0.05). The best equalization of body weight of five-week old piglets was found in groups E3 and E1. The piglets from group E3 consumed the greatest quantity of fixed feed until weaning; in the mentioned group, the body weight gain in total was the highest one (8.44 kg/head). The mean daily gains of the piglets from group E3 were equal to 241 g and they were higher as compared to groups E1 and E2 by 5.24 and 12.62%, respectively. Consumption of solid feed per gain of 1 kg of body weight of the litter amounted in groups E1, E2 and E3 to 4.80, 3.49 and 4.65 kg, respectively. The mentioned index was low what indicates a good milk performance of the sows. All three employed preparations fulfilled their prophylactic function and prevented incidence of anaemia symptoms.

Key words: piglets, iron (Fe), Fe preparations

INTRODUCTION

The reared piglets are expected to reveal good health, quick growth rate and good feed conversion. Therefore, in the case of young pigs, which show a high, genetically determined growth potential, administration of iron-containing preparations is indispensable. They affect favourably metabolism and immunological mechanisms as well as growth and development of neonatal animals (Kostro et al. 2004, Madej et al. 2005, Salle and Auvigne 2006, Winnicka et al. 2012). Deficit of Fe is favourable for anaemia, lowering of resistance, incidence of diseases and increased death rate. The piglets which are inappropriately supplied with iron grow more slowly and reveal worse feed conversion what prolongs the period of reaching the optimum body weight from viewpoint of their safe weaning from mother (Svetina et al. 2006, Maes et al. 2011). Supply of iron in a form of preparations, being injected or administrated *per os* where Fe occurs in organic or inorganic form, with a regulating role of hepcidine, constitutes a protection of the piglets from

anaemia (Grela et al. 2005, Sokołowska and Klimek 2008). The composition of iron-containing preparations and their quality and form of administration are different what may cause somewhat different although most frequently positive response of organism of the animal which receives them (Wasiński et al. 1995, Madej et al. 2000, 2005, Czech et al. 2003, Krasucki and Orlicki 2008, Winnicka et al. 2012).

The aim of the studies was to determine the results of rearing the piglets kept in the uniform conditions and fed the same way but receiving three different Fe preparations by injection.

MATERIAL AND METHODS

The studies were conducted in a private pig house in III and IV quarter of 2013. The observations included piglets from 15 litters coming from multiparous PWL sows (3–6 reproduction cycle) mated with crossbred boar F1 (Duroc × Pietrain). The sows were transferred to farrowing pens (three-part pens) 4–5 days before the expected date of farrowing. The animals were kept in accordance with the standards (Rozporządzenie 2010).

The sows were assigned at random to three experimental groups E1, E2 and E3; the number of the piglets, born by the females in the mentioned groups, amounted to 67, 56 and 60 animals, respectively. On the third day of life the piglets received iron-containing preparation (intramuscular injection, behind the ear); the dose of the preparation was consistent with the producer's recommendations; the classified piglets received different preparations (Table 1). Since 10th –14th day of life, the piglets were additionally fed the full-ration mixture of prestarter type. One week before weaning, the loose mixture of starter type was introduced (Table 2). The piglets were weaned at the age of five weeks.

TABLE 1. Preparations administrated to piglets in the experimental groups E1, E2 and E3

Experimental groups / preparation					
E1 / A		E2 / B		E3 / C	
Active substance	Dose (mg/ml)	Active substance	Dose (mg/ml)	Active substance	Dose (mg/ml)
Complex of iron hydroxide(III) and dextran	200	complex of iron(III) and dextran	100	complex of dextran and iron(III)	586
				pentasodium selenate	0.998
				copper chloride	0.00403
				thiamine hydrochloride	0.03
				vitamin B_2	0.01
				pyrodoxine hydrochloride	0.025
				cyanocobalamin	0.08
				nicotinamide	0.4
				pig serum	to 1 ml

Source: According to the producer's data.

TABLE 2. Raw materials of feed and energetic value as well as the content of nutrients (%) in 1 kg of the mixture

Specification	Mixture	
	Prestarter	Starter
Feed raw materials	barley, wheat, maize, soy extraction meal, products of oil and dairy industry, soy oil, calcium phosphate, calcium carbonate, sodium chloride, and dietetic additives and antioxidants	wheat, barley, maize, soy extraction meal, maize brans, maize DDGS, wheat brans, products of food industry, potato protein, calcium phosphate, vegetal oils, calcium carbonate and dietetic additives and antioxidants
Metabolic energy, MJ	13.75	13.60
Crude protein	18	16
Crude oil and fat	3–4	3–4
Crude fibre	3.0–3.5	2.5–3.5
Crude ash maximum	5	5
Total phosphorus	0.7	0.7
Calcium	0.83	0.83
Sodium	0.24	0.25
Lysine	1.43	1.20
Methionine	0.54	0.46
Methionine + Cysteine	0.82	0.83

Source: According to producer's data.

At birth, the whole litters of the piglets were weighed; at weaning, each piglet was weighed individually; daily body weight gains of the piglets were assessed. The quantity of the consumed mixture, its utilization as well as diseases and deaths of the piglets were controlled.

In nutrition of the sows, own mixtures were employed; they included the following components: cereals – barley, triticale, rye, oats, and legumes – pea or lupine of own cultivation as well as commercial protein and mineral components, soy and rape extraction meals, wheat brans, calcium carbonate, acidifier and premix: for suckling sows – Rolmix LK 4% Q; for loose sows – Rolmix LP 2.5%. The sows received the feed twice a day, with a constant access to water.

The piglets were subjected to the basic care and prophylactic treatment: day 1 – clipping the canine tooth and abbreviation of tails; day 3 – administration of iron and Baycox preparation (against coccidiosis); day 5–7 – castration of piglets. At the age of about 21 days, the piglets were vaccinated against *Mycoplasma hyopneumoniae* (preparation Ingelvac MycoFLEX) and at weaning, the animals were dewormed (intramuscular preparation Paramectin). After weaning, the animals received, as prophylactics, the solution of Colivet preparation for five days (against oedema disease).

The sows were regularly dewormed and vaccinated against swine erysipelas and parvovirus (preparation Parvoruvax).

Statistical analysis of the traits concerning the piglets was carried out by Kruskal-Wallis test, with the utilization of package IBM SPSS Statistics 21. The table contains the mean values and standard error of the mean (*SEM*). The mean values were given for the following traits: feed intake and consumption by the litter and gain of body weight of the litters.

RESULTS AND DISCUSSION

In each of the examined three groups, the cases of diarrhoea were found in one litter. Besides it, from among the piglets of one litter from group E1, the cases of streptococciosis were recorded.

The best results of rearing and growth were obtained in the piglets from group E3 ($P > 0.05$) – Tables 3 and 4.

TABLE 3. Results of reproduction and rearing of the piglets

Traits	Groups		
	E1	E2	E3
Number of the piglets born alive (heads)	63	71	64
Number of the piglets weaned from the litter* (heads)	57	56	60
Number of piglets born (heads)			
mean	12.60	14.20	12.80
min–max	10–15	12–17	11–17
SEM	0.812	0.800	1.200
Number of piglets reared (heads)			
mean	11.40	11.20	12.00
min–max	10–13	7–14	11–14
SEM	0.510	1.241	0.632
The mean body weight of the piglet on day 1 (kg)			
mean	1.81	1.49	1.71
min–max	1.50–2.22	1.24–1.71	1.35–1.91
SEM	0.118	0.078	0.110
The mean body weight of the piglet on day 35 (kg)			
mean	9.81	8.97	10.15
min–max	8.82–10.44	7.91–10.47	9.26–11.00
SEM	0.288	0.452	0.281
Body weight gain in total at 1–35 day (kg)			
mean	8.00	7.48	8.44
min–max	7.32–8.43	6.67–9.05	7.69–9.09
SEM	0.192	0.455	0.237
The mean daily body weight gain (g)			
mean	229	214	241
min–max	209–241	191–259	220–260
SEM	5.478	13.000	6.768

* Including overlying cases in groups E1, E2, E3; other causes of deaths: in group E2 – five piglets, in E3 – one piglet.

TABLE 4. Body weight gain of the litter and intake and utilization of feed

Traits	Groups		
	E1	E2	E3
Gain of body weight of the litters (kg)	40.0	37.4	42.2
Feed intake by the litter until weaning (kg)	38.4	26.1	39.3
Feed conversion per 1 kg of body weight gain of the litter (kg/kg)	4.80	3.49	4.65

The piglets from groups E1 and E3 as compared to the animals from group E2 were also more equalized at weaning. The comparison of the results of rearing the piglets and the literature data indicates a practical utility of the employed preparations in prophylaxis of anaemia what is supported by a good rate of growth in the herd (Salle and Auvigne 2006, Krasucki and Orlicki 2008).

The better results of rearing the suckling piglets from group E3 could be affected by the employed preparation. Its components have the capability of counteracting the formation of free radicals; they also participate in oxidation and reduction reactions and affect the changes of iron in the body (Ku et al. 1983, Schollenberger 1984). The changes of iron are determined by the level of different elements in the organism; the mutual interactions between iron and copper in organs and in blood were examined (Yip et al. 1985, Dove and Haydon 1991). The supplementation of microelements cannot be excessively high as the surpluses of some of them e.g. copper, and cobalt, zinc, manganese, may have an antagonistic effect in relation to iron, what is favourable for lowering of its content in liver (Kujawiak 1996).

In case of different resources of iron in the organism and external supply, the rate of growth of the piglets may vary. Its deficit is favourable for lowering of the growth rate and body weight of the piglets; it may also lead to anaemia. Initially, the limited level of iron results in lowering of its concentration in the spleen, liver and kidneys, and the increase of the efficiency of regulatory proteins for binding of iron. On the successive stage of deficit, the concentration of haemoglobin and Fe in the blood as well as myoglobin in the muscles is reduced. The third stage of iron deficit causes disfunctions of changes which are dependent on the mentioned element. The level and functioning of cytochrome oxidase c, and building-in of iron into hem which is found in the content of haemoglobin and myoglobin is important (Rincker et al. 2005). Deficit of iron forces greater and greater absorption of the discussed element in intestines. Fe excess may cause haemochromatosis or haemosyderosis, being a consequence of greater binding and absorbing of iron in the organism (Svoboda and Drabek 2005, Lipiński and Starzyński 2006). The mentioned changes are rarely observed because the excess of iron in physiological conditions is removed from organism (Artym

2008). The excess of iron may be toxic as a free form of this element participates in formation of free radicals which damage DNA, lipids and proteins. It affects negatively the growth and development of animals (Floriańczyk and Sidorowska 1995, Andrews 2002, Chung and Wessling-Resnick 2003). In the regulation of the processes, hepcidine is also participating factor (Ganz 2003).

In the studies, it has been demonstrated that iron is the element, affecting positively blood parameters and the growth, development and health state of the piglets (Wasiński et al. 1995, Madej et al. 2000, Czech et al. 2003, Kostro et al. 2004, Salle and Auvigne 2006, Winnicka et al. 2012).

Most of the piglets examined in the own studies was characterized by a good rate of growth; their mean body weight at weaning was high. The results were determined by summed effect of several factors; it included the age of the piglets at weaning, good health state and correct supply of the piglet organism in iron. The exception concerned the piglets from group E2, the body weight of which at weaning and body weight gains were lower than it should be expected (Krasucki and Orlicki 2008) but it might be the consequence of somewhat lower body weight of the piglets at birth.

In the own studies, the comparison of three preparations, being intramuscularly injected, was carried out. The mentioned way of administration is better as compared to e.g. *per os* form due to easiness of administration, precise dose and rate of penetration of the preparation to blood circulation (Czech et al. 2003, Rekiel 2013). Kołacz et al. (2001) compared the blood parameters which reflect the management of iron and they found that iron fumarate given in a form of paste, and the liquid as administrated intramuscularly – where iron dextrate was the active substance – were comparable in respect of the quality.

Saturation of transferrine with iron was similar what indicated the comparable availability of the studied preparations.

Winnicka et al. (2012) showed the statistically lower ($P \leq 0.05$) gains of the piglets which received iron preparation in a form of powder vs the group which received another preparation by injection. The authors demonstrated, however, the significantly higher ($P \leq 0.01$) concentration of iron in blood of the suckling piglets, receiving the preparation in a form of powder *per os*, as compared to the injected preparations.

In the case of own studies, the administration of the iron preparation protected the piglets from occurrence of anaemia what is manifested by a good rate of growth and the results of rearing the piglets.

CONCLUSIONS

The results of the conducted study allow stating as follows:

– The highest body weight of five-week piglets was found in group E3: the pig-

lets from the mentioned group were higher vs the piglets from groups E1 and E2 by 3.47 and 13.15%, respectively ($P > 0.05$).

- The best equalization of body weight of five-week piglets was recorded in groups E3 and E1.
- The piglets from group E3 consumed the highest quantities of fixed feed until weaning and in the mentioned group, the body weight gain in total was the highest one (8.44 kg/head).
- The mean daily gains of the piglets from group E3 amounted to 241 g and were higher by 5.24 and 12.62%, respectively, as compared to groups E1 and E2.
- The utilization (conversion) of solid feed per gain of 1 kg of the body weight of the litter in groups E1, E2 and E3 was equal to 4.80, 3.49 and 4.65 kg/kg, respectively. The mentioned parameters were low what indicates a good milk performance of the sows.
- All three preparations which were employed in the studies, fulfilled their prophylactic function and prevented occurrence of the symptoms of anaemia.
- The piglets from group E3 were characterized by the highest growth rate and a good state of health. The obtained results indicate the practical suitability of the employed preparation in the herd.

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Streszczenie: *Porównanie wyników odchowu prosiąt otrzymujących różne preparaty żelaza.* Celem badań było określenie wyników odchowu prosiąt otrzymujących iniekcyjnie trzy różne preparaty żelaza. Lochy, których potomstwo objęto obserwacjami, przed porodem przydzielono losowo do jednej z trzech grup doświadczalnych – E1, E2 i E3 (każda po pięć loch). Kontrolowano tempo wzrostu, wykorzystanie paszy i stan zdrowia prosiąt od urodzenia do odsadzenia (35. dzień życia). Największą masę ciała pięciotygodniowych prosiąt stwierdzono w grupie E3; różnica w stosunku do masy prosiąt z grup E1 i E2 wyniosła odpowiednio 3,47 i 13,15% (p >0,05). Najlepsze wyrównanie masy ciała pięciotygodniowych prosiąt stwierdzono w grupach E3 i E1. Prosięta z grupy E3 pobrały najwięcej paszy stałej do odsadzenia i w tej grupie przyrost masy ogółem był największy (8,44 kg/szt.). Średnie dobowe przyrosty prosiąt z grupy E3 wyniosły 241 g i były większe względem grup E1 i E2 o odpowiednio:

5,24 i 12,62%. Zużycie paszy stałej na przyrost 1 kg masy miotu wyniosło w grupach E1, E2, E3 odpowiednio: 4,80, 3,49 i 4,65 kg. Wskaźnik ten miał małą wartość, co wskazuje na dobrą mleczność loch. Wszystkie trzy stosowane preparaty spełniły swoją profilaktyczną funkcję i zapobiegły wystąpieniu symptomów niedokrwistości.

Słowa kluczowe: prosięta, żelazo (Fe), preparaty żelaza

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